10/560382
IAP9 Rec'd PCT/PTO 13 DEC 2005

P036650/WO/1

DaimlerChrysler AG

Watts strut

The invention relates to a Watts strut according to the preamble of claim 1.

Watts struts as stabilizer members for a chassis of a vehicle are already known. The Watts strut is part of the Watts linkage, which is basically used in rigid-axle vehicles in order to reduce lateral movements of the rigid axle. In the Watts linkage a lever, rotatably supported at the center, is supported on the differential, for example, and is carried to either side by Watts struts of equal length fixed to the vehicle body. This articulation only permits a precise vertical movement of the lever. In alternative embodiments the lengths of the two Watts struts may differ from one another.

The patent specification DE 100 14 603 C2 discloses a Watts strut which is formed from a long strut body as profile section. In cross-section the strut body is, at least axially in sections, open on one side and in the longitudinal direction is joined from at least two profiled parts arranged axially in tandem. The profiled parts are arranged partially overlapping one another in the longitudinal direction and are joined together in the overlap area.

The object of the invention is to specify a Watts strut which can be produced to a high quality with low production costs.

According to the invention the object is achieved by the features of claim 1.

According to the invention a Watts strut is formed by a strut body produced by hydroforming. One advantage is that Watts struts can be formed with high precision and have only a relatively low weight. Various joining operations are dispensed with and problems of corrosion, which can occur with welded parts, are eliminated. These advantages accrue in particular when additional structures, such as a bush for the accommodation of a rubber bearing, are integrally formed in the hydroforming process. A complex Watts strut geometry is furthermore possible.

Further advantages and developments of the invention are set forth in the description and in the further claims.

The invention is explained in more detail below with reference to a drawing, in which:

Fig. 1 shows a left-hand (Fig. 1a) and a right-hand (Fig. 1b) Watts strut with a suspension link eye and fixing part and

Fig. 2 shows two Watts struts in the fitted position.

A left-hand (a) and a right-hand (b) Watts strut are depicted in Fig. 1. The left-hand Watts strut 1 has a long, twisted strut body, at one axial end of which a bearing bush 12 is arranged, and at the other axial end of which a U-shaped end section 11 is arranged. The strut body extends along a longitudinal axis L1. The bottom of the U-shaped end section 11 is formed by the Watts strut itself. The two legs of the U-shaped end section 11 pointing away from the strut body in the direction of the longitudinal axis L1 each have a hole, which is provided for fixing to a connecting device, which connects the two Watts struts 10, 20 together. The cross-section of the strut body is approximately

rectangular. One face 16 of the strut body has a first face section 13 close to the bearing bush 12 and a second face section 15 close to the U-shaped end section 11. Along the longitudinal axis L1 the strut body is twisted by approximately 90° about the longitudinal axis L1, so that the face 13 at the bearing bush 12 is aligned approximately perpendicularly to the corresponding face 15 at the U-shaped end section 11. The strut body has a bend 14 approximately in the middle, so that the strut body is there separated at an angular distance from the longitudinal axis L1.

The right-hand Watts strut 20 in Fig. 1b is of similar design and extends along a longitudinal axis L2 with a long, twisted strut body, at one axial end of which a bearing bush 22 is arranged and at the other axial end of which a U-shaped end section 21 is arranged. The right-hand Watts strut 20 also has a bend 24, so that at the bend 24 the strut body is separated at an angular distance from the longitudinal axis L2. A twisting of the right-hand Watts strut 20 is discernible at the face 26, which has a face section 23 at the bearing bush 22 and a face section 25 at the U-shaped end section 21, the sections being opposed at a finite angle to one another. The Watts struts 10, 20 according to the invention have a relatively low weight, since they do not need any internal stabilizing elements, and joining flanges and the like are eliminated.

Fig. 2 shows an exploded view of the two Watts struts 10, 20 with a connecting device 30 in the fitted position. The U-shaped end sections 11, 21 are united and are fixed in the connecting device 30 to a lower shell 31 and an upper shell 32. The two shells 31, 32 envelop the end sections 11, 21 of the two Watts struts 10, 20. At the same time both end sections 11, 21 are articulated on pivots in the connecting device 30. The

connecting device 30 is finally fixed approximately centrally to an axle or a differential in the usual way, whilst the outer bearing bushes 12, 22 are in the usual way intended for bearing support on a vehicle body arranged on both sides of a vehicle.

Watts struts 10, 20 according to the invention may naturally also have a different geometry.

For producing the Watts strut 10, 20 according to the invention a hollow blank workpiece, for example a tubular or profiled section is preferably expanded in a forming tool through the action of a fluid pressure acting inside the workpiece and by forces applied externally to the ends of the workpiece. These forming stresses cause the wall of the blank workpiece to conform to the enveloping forming tool. In order to avoid folding and cracking, a suitable axial force acts on the workpiece simultaneously with the internal pressure. A workpiece geometry corresponding to this shape is produced.

Suitable materials that can be worked by this method include all materials having sufficient deformability, especially all cold-formable materials which are also used for deep-drawing or extrusion. The use of light metals, particularly aluminum or aluminum alloys, is especially advantageous, since this permits a further weight-saving.

Where aluminum alloys are used for a preferred Watts strut 10, 20 the relatively low deformability compared to steels and the much greater roughening due to the larger grain size must be taken into consideration. The use of hot age-hardening alloys is particularly advantageous because of the scope which they afford for adjusting the strength distribution in the workpiece in advance through a simple heat treatment, whilst the workpiece blank is yet unformed, so that in the forming

of the (cooled) workpiece the material flow can be influenced to a significant degree. The lower yield stress of aluminum alloys compared to steel moreover affords the facility for optimizing the material flow and hence the forming process through even small additional forces, generated by an external flow, for example. Highly complex geometries of the preferred Watts struts 10, 20 can thereby be achieved.

Among other things, a precise knowledge of an objective process control, by means of which the application of the internal pressure and the mechanical stresses are controlled with a view to the desired outcome of the forming process, is advantageous for the use of this method. This is suitably optimized through repeated simulations of the hydroforming process.

The technology of hydroforming is capable of advantageously meeting the requirements for lightweight vehicle construction. Hydroforming offers a number of advantages over the conventional manufacture of such workpieces. It is possible to produce load-adjusted, cross-sectional shapes along straight or curved component axes without strength or rigidity-reducing joints, whilst at the same time saving workpiece material. It is furthermore possible to produce parts with a high degree of integration, saving the need for joining operations and thereby making it possible to eliminate joining flanges and to dispense with tolerance-compensating measures. In addition, the method may also be combined with other machining processes, such as perforation and bending under internal pressure. Workpieces can furthermore be produced with great dimensional and geometrical accuracy without the delay incurred due to welding influences.